Space Weather Technical Forecast

Issued on Sunday, 20 August 2023 at 13:17 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-class flares (R1-R2; Minor-Moderate radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is low, with the peak flare reaching C3.7 at 20/0626 UTC from a small sunspot in the northwest, AR3409. Background X-ray flux otherwise remains subdued. There are eight sunspot regions on the facing side of the Sun. Little overall change in the sunspots which were generally magnetically simple and stable. A few Coronal Mass Ejections (CMEs) were visible in the past 24 hours. Notably later in the UTC day of 19 August east limb dimming was observed with a CME from around the solar equator at 19/1500UTC. This is not expected to affect Earth. This event could suggest that Ex-AR3386 may have survived in some form at this location - something of relevance for the X-ray forecast - and eventually the geomagnetic and solar radiation forecast should it survive for any length of time. The final main noted event was a filament eruption from the vicinity of AR3403 in the northwest at 19/1800UTC. No Earth-directed CMEs feature in the forecast.

Solar Wind / Geomagnetic Activity: The solar wind as measured by DSCOVR and ACE at L1 started at slightly elevated levels around 430 km/s and steadily became enhanced through the period to reach elevated to strong levels by the end of the period with a peak of 690 km/s noted at 20/1200 UTC. This had been thought to be due to CH35/-, but a resurgence within the same sector later in the UTC day may represent either reconnection or else transfer to an unidentified hole of the same polarity. The solar wind suggests Earth is transiting a sector of space characterised by a negative polarity fast wind. The density in the solar wind was at mostly average levels, with a peak of 9ppcc recorded at 19/1600 UTC. The phi angle was accordingly almost exclusively negative (towards the Sun). The magnetic field, IMF (Bt) was mostly weak with a peak 10nT at 20/0525UTC, with some incursions to moderate levels. The north-south component, Bz, ranged between +9 and -6nT, with a slight positive bias overall, but not spending protracted periods either co- or anti-aligned with Earth's field. The net result of the above solar wind measures was for Quiet to Unsettled geomagnetic activity (Kp1-3).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux remained at Background levels. GOES16 high energy (greater than 2MeV) electron flux ranged from Moderate to Normal Background levels, with the associated 24-hour fluence well below the Active level, with an observed value of 2.71e6 integrated pfu at 20/0001UTC, and a mostly flat trend.

Four-Day Space Weather Forecast Summary

Solar Activity: Activity is most likely to remain low, perhaps showing an uptick with the arrival of far-sided groups (that were very active as they left the Earth-facing side) into the new UTC

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week. The most likely region to produce an M-class flare is currently AR3407 (Dso/Beta) in the southwest.

Solar Wind / Geomagnetic Activity: Solar winds, probably enhanced by CH35/-, are most likely to decline over coming days to slightly elevated by day 3 (22 August) and perhaps occasionally to Low levels thereafter. No further fast winds are anticipated this period and no Earth-directed CMEs feature in the forecast. Geomagnetic activity is forecast to be mostly Quiet (Kp1-2) throughout, but for the next 24 hours an unsettled or active interval (Kp3-4) remains possible.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to remain at Background levels. High energy electron flux (greater than 2MeV) will probably show an increase as CH35/- wanes, with diurnal peaks reaching Moderate, possibly High into the new UTC week. The associated 24-hour fluence is expected to start below Active (1e8 integrated pfu), but with a probable upward trend in coming days.

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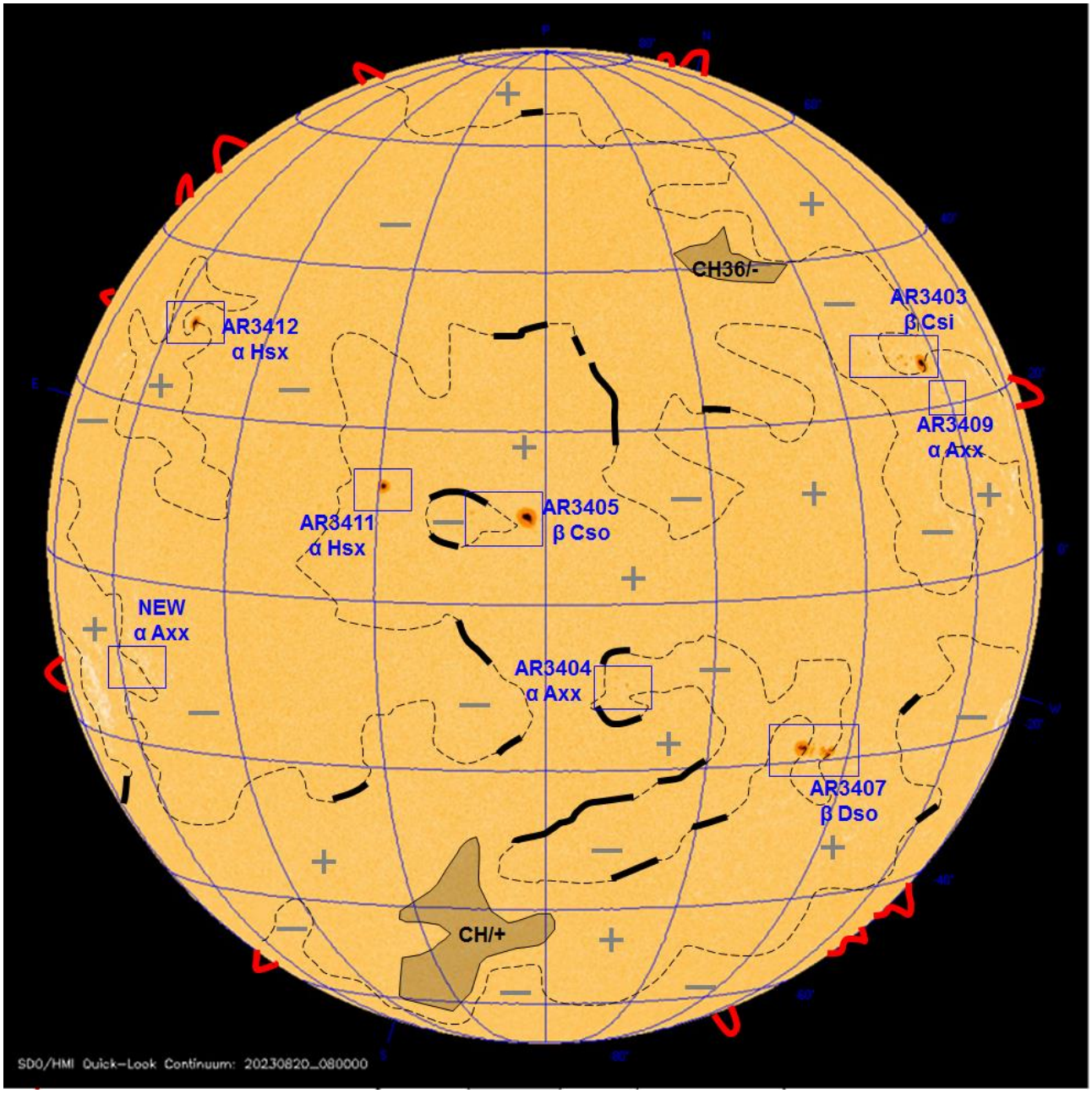
Figure 1. Solar Analysis Valid 0800UTC, 20 August 2023.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

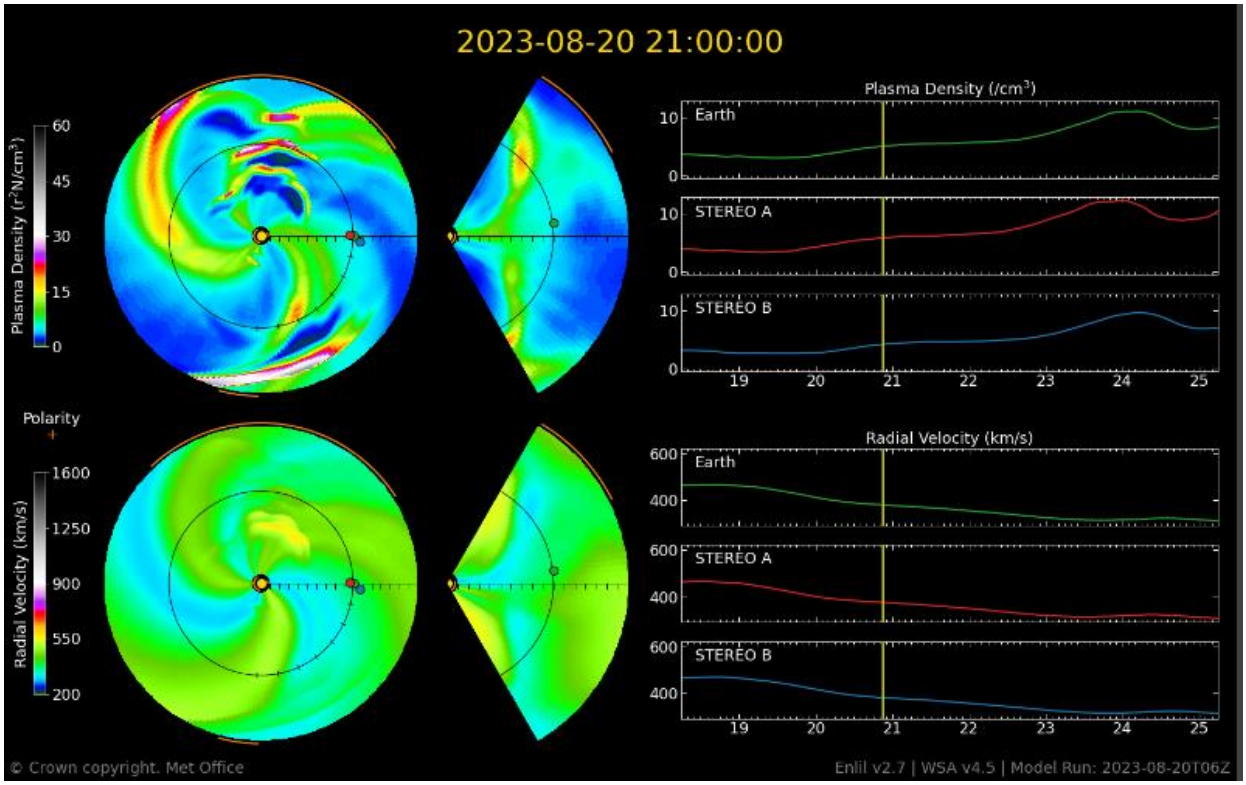
No Earth-directed CMEs currently feature in the forecast period. Solar winds, probably enhanced by a HSS related to CH35/-, are most likely to decline over coming days to slightly elevated by day 3 (22 August) and perhaps occasionally to Low levels thereafter. No further fast winds are anticipated this period. Geomagnetic activity is forecast to be mostly Quiet (Kp1-2) throughout, but for the next 24 hours an unsettled or active interval (Kp3-4) remains possible. No further HSS are forecast to affect Earth this period.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil

Figure 2: Latest available MOSWOC Enlil run (labelled 06Z), showing exit from the current fast wind from CH35/- which is more marked than shown.



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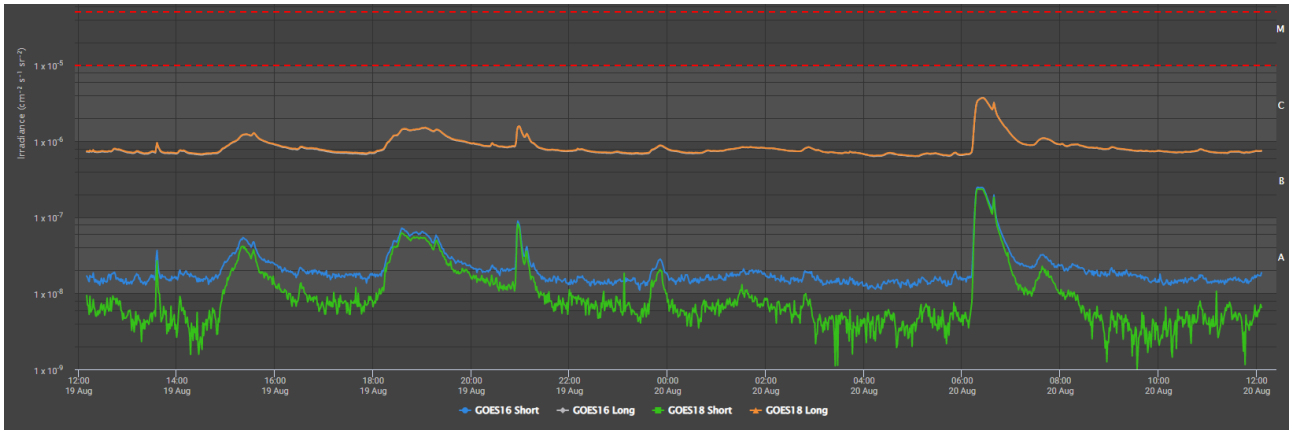
Radio Blackouts - X-Ray Flares:
Solar activity has been at Low levels during the past 24 hours. The 10.7cm Penticton flux value is now relatively low at 151sfu (from a midweek high of 160). This will probably rise higher due to enhanced flux arriving over the eastern solar horizon, which is likely to dictate a forecast uptick in activity into the new UTC week. The eastern solar horizon will shortly reveal the Carrington location for the previously active Ex-3386 (in the northern hemisphere) of roughly a fortnight ago. It is possible that a survival here is part of the cause of the witnessed instability and CMEs released from its vicinity in the past 24 hours. Given the largely quiet front side, additions from the east are considered likely to increase the risk of M-class flares counteracting more minor western horizon losses through this guidance period.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	30	30	30
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: X-ray flare flux at GEO from GOES data showing a few C-class flares over past 24 hours.



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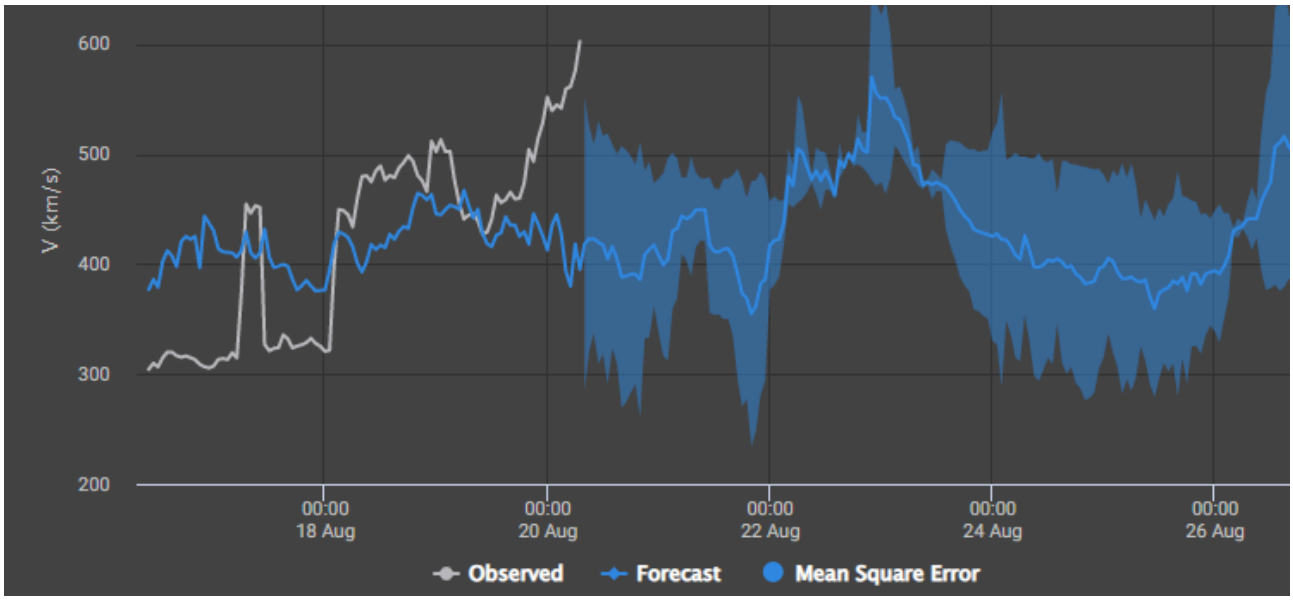
Solar Radiation Storms - (High Energy Protons):
High energy (greater than 10MeV) proton flux observed by GOES16 is expected to remain at Background levels. There persists an ongoing and very gradually increasing Slight Chance of proton flux increases from any significant flares, perhaps most likely from the western solar hemisphere, however these are considered very unlikely to reach S1 Minor Solar Radiation Storm levels.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	5	5
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 4: Met Office Solar Winds Prediction Model (SWPM) showing the current strong high speed stream.



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High Energy Electrons Event (≥ 2MeV):
The high energy (greater than 2 MeV) electron flux remains close to Normal Background levels. A potentially strong recovery in flux at GEO is likely as the HSS from CH35/- wanes, and also given the current lack of any significant geomagnetic activity. . Current guidance is for diurnal peaks to reach Moderate, possibly High levels into the new UTC week. The associated 24-hour fluence is expected to start below Active (1e8 integrated pfu), but with a probable upward trend in coming days. Probabilities have therefore been lifted in the table above to cater for this probable increase in activity.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	20	30	50
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	5

Figure 5: High energy electron flux at GEO and Met Office REFM guidance.

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